The Mucus Holdfast of *Littorina irrorata* and its Relationship to Relative Humidity and Salinity

BY

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(7 Text figures)

INTRODUCTION

The salt marsh periwinkle, *Littorina irrorata* (Say, 1822), is common in salt marshes along the eastern coast of the United States from New York State to central Florida, and along the northern coast of the Gulf of Mexico. The species shows a disinclination to remain submerged and is usually found attached, by dried mucus, to marsh grasses above the water level, or foraging on marsh floors exposed at low tide.

Many other members of the family Littorinidae have, as well, been noted to employ a small amount of dried mucus (or holdfast) for attachment of the shell to substrates during periods of air exposure.

During a recent study of the species' behavior (Bingham, in press), the process of holdfast formation, and the relationship of holdfast formation to relative humidity and salinity were observed.

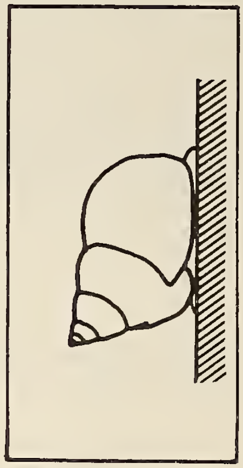

Figure 1

Normal spire-down position of *Littorina irrorata*

HOLDFAST FORMATION

The animal assumes a spire-down position (Figure 1) before secretion of the holdfast is begun and then, with the anterior end of the pedal sole, performs a single slow sweep of the uppermost interior portion of the shell lip. This action is depicted in various stages in Figure 2, and was completed in an average time of 9½ minutes by 20 specimens. Re-orientation into the spire-down position, when the vertical substrate was inverted, was seen so long as the pedal lick had not begun. After the pedal lick had started, inversion of the substrate did not visibly affect holdfast formation, and an unstable position, as seen in Figure 3, resulted.

The holdfast consists of 2 semicircular films of mucus attached to the substrate and joined along a line of shell attachment (Figure 4). This line is shown in Figure 5 to lie slightly within the shell lip.

EFFECTS of RELATIVE HUMIDITY

In studying the effects of various relative humidities on the latency of holdfast formation, 50 adult specimens were kept submerged in ambient sea water of 33‰ salinity for 1 hour, dried with a paper towel, and 10 each placed in 5 jars of one gallon capacity containing stable relative humidities of 0%, 25%, 50%, 75%, and 100%. These hu-

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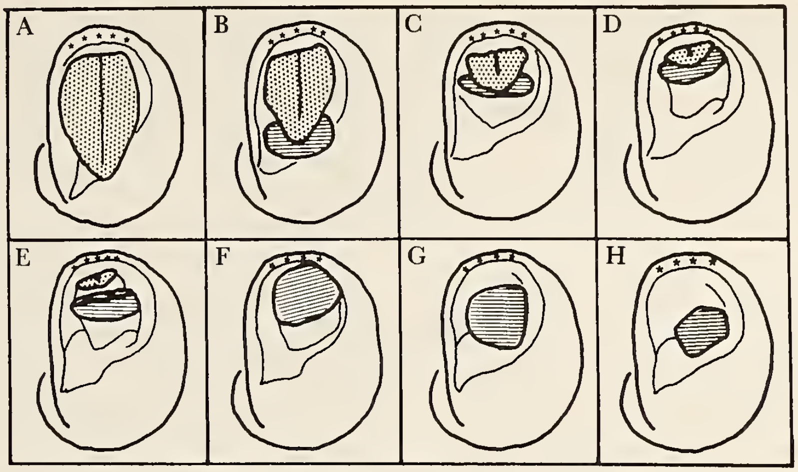
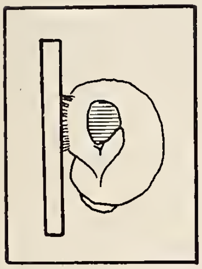


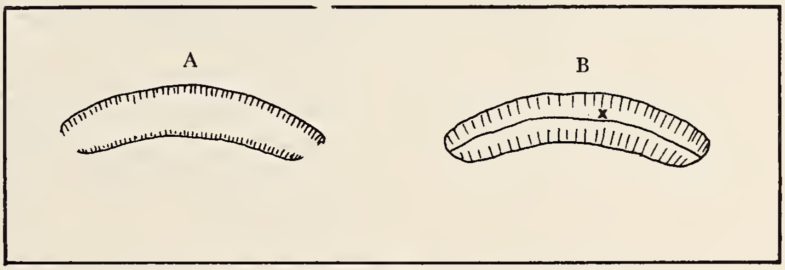
Figure 2

Stages in pedal sweep during holdfast formation

foot operculum

**** region in which holdfast is formed





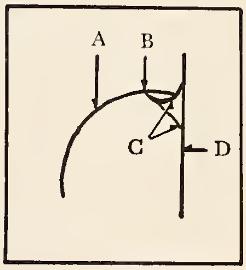


Figure 4

Holdfast of *Littorina irrorata*

A as seen through a glass substrate

B as seen with animal removed X line of shell attachment

Figure 3

Unstable attached position as viewed from above

Figure 5

Holdfast of *Littorina irrorata,* cross section

A shell B point of shell attachment C holdfast

D substrate

midities were created by placing in each jar a bowl containing sulphuric acid solutions of known concentrations and a known constant temperature (25° C), according to the method described by Salomon (1951).

The length of time before each specimen was seen to complete a holdfast was noted and the average time in each group calculated. All of the specimens in relative humidities of 75% and below formed holdfasts, with each group forming them in a shorter average time than the group kept at the next higher level of relative humidity (Figure 6). None of the specimens kept in the 100% relative humidity atmosphere formed a holdfast during 3 days of observation.

EFFECTS of SALINITY

In the determination of salinity effects on holdfast formation, 140 specimens which had been kept submerged in ambient sea water of 33‰ salinity for one hour, were placed, 10 each, in 14 different salinities ranging from that of tap water to 75‰. The solutions were aerated and

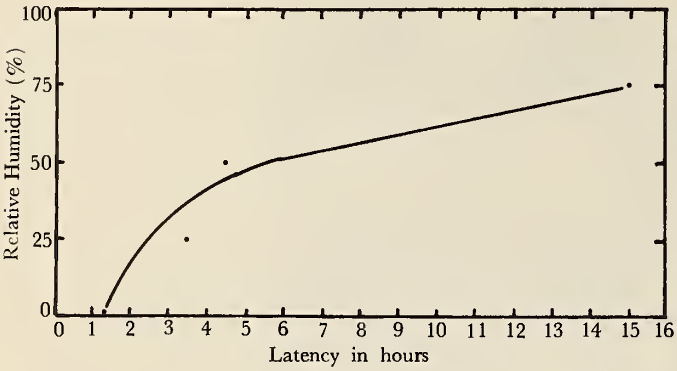


Figure 6

Latency of holdfast formation as related to relative humidity

maintained at a temperature of 25 ± 1° C. Plastic screen cages were used to keep the snails submerged. Low salinity solutions were prepared with sea water and distilled water. Solutions of higher than normal sea water salinity were prepared by evaporation of sea water. Salinity determinations were made with a Goldberg refractometer.

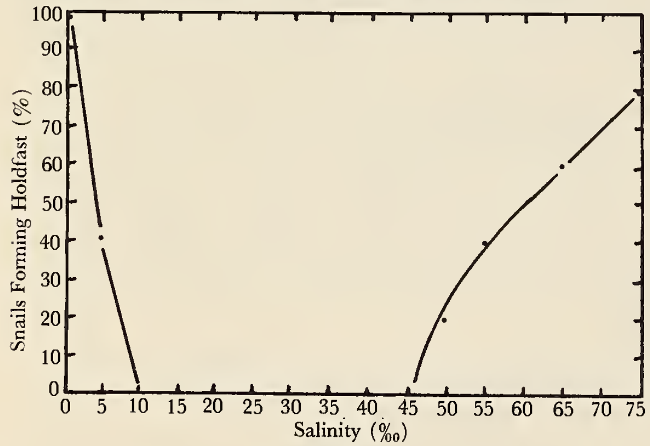


Figure 7

Occurrence of holdfast formation as related to salinity

In Figure 7, which illustrates the relationship of holdfast formation and salinity, it may be noted that at only one salinity – that of tap water – did all of the snails form a holdfast; therefore, the percentage of snails forming holdfasts is presented rather than the latency of holdfast formation.

No holdfasts were formed (during 3 days of observation) by the specimens maintained in the 10 to 45‰ salinity range. Above 45‰ salinity, the percentage of specimens forming holdfasts increased as salinity increased. Below 10‰ salinity the percentage of specimens forming holdfasts increased as salinity decreased.

DISCUSSION

The holdfast is seen as a valuable adaptation to the supralittoral environment in that it affords a means of maintaining position without continued exertion and leaves the snail free to withdraw into its shell to escape environmental stress conditions, such as low relative humidity or low and high salinities when such salinities cannot be avoided through upward movement.

In this study, the holdfast was formed only during unfavorable conditions and was secreted under water as well as in the air. Upon appropriate stimulation, the holdfast was disposed of through feeding movements of the proboscis and radula.

Literature Cited

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